



Local Land
Services



Australian Government



Building landscape resilience

What you can do on your
property to help improve the
health and resilience of the
local landscape





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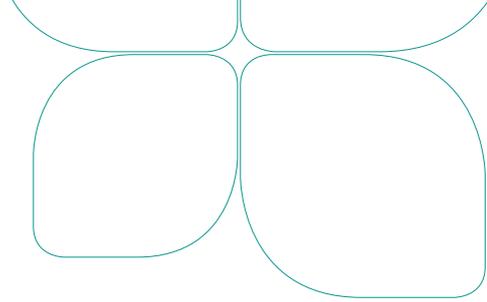
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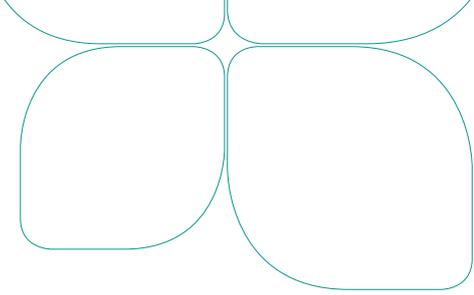


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Introduction



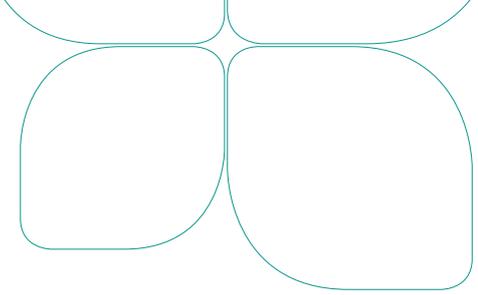
Introduction

The Central West Local Land Services region covers a large area, consisting of a wide range of landforms, soil types and vegetation formations. The region's diverse landscape includes major river systems (Macquarie, Lachlan, Bogan and Castlereagh), mountain ranges (Warrumbungles and Harvey Ranges) and expansive plains. Soil types vary from extremely fragile to some of the most robust and productive in Australia. The region is also the divide between the semi-arid and temperate zones, which contributes to the fantastic diversity of plant and animal species found within the region.

This diversity provides the basis for a region with strong landscape 'resilience'—an ability to recover from disturbance. However, the Central West landscape has been significantly modified,

with a long history of disturbance for agricultural production and other human development. Over time, this repeated disturbance to the environment has lowered the resilience of the landscape and resulted in a dysfunctional landscape that, in some areas, cannot repair itself.

A significant, strategic effort is required to restore landscape resilience in the Central West to ensure that the region continues to boast a diversity of natural attributes while supporting agricultural production and other human activities. This guide outlines some key concepts that you can adopt on your property to help build landscape resilience.



What is landscape resilience?

Landscape resilience is the ability of the natural landscape and ecosystems to recover from disturbances such as clearing, grazing, windstorms, landslides, fire, drought, flood, climatic variations, chemical use, weed invasions or predation.



These photos show landscape resilience in action. The top photo shows native trees and shrubs regenerating after a bushfire. The bottom photo shows native trees and groundcover regenerating after many years of clearing and grazing. Photos: Simone Cottrell/ OEH (top) and Mikla Lewis (bottom).

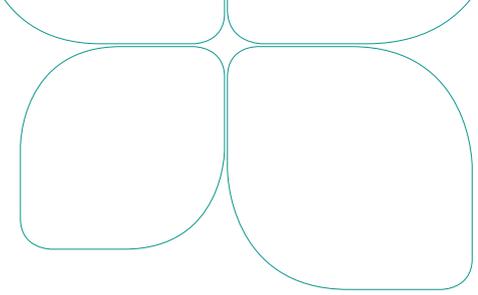


Ant on golden everlasting daisy



Acacia seedling

Plants and animals (from microscopic to large) all have some level of resilience that has evolved over millions of years in response to disturbances. This resilience of individual plants and animals governs the capacity of the whole ecosystem to absorb disturbance, without being significantly altered in its basic function or structure. Photos: Mikla Lewis.

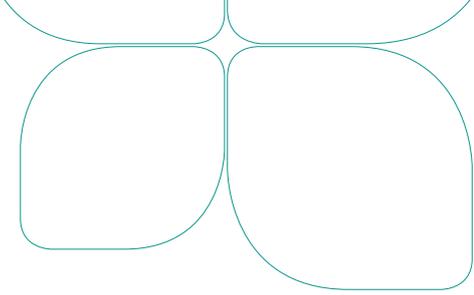


Natural disturbances and environmental variations are not only expected but essential to trigger landscape renewal and generate biodiversity. However, disturbances of sufficient magnitude or duration can affect an ecosystem so much that it cannot recover and is forced beyond a threshold, permanently altering its function or structure.

Such is the case in some parts of the Central West region where actions such as the removal of deep-rooted native vegetation, destruction of habitat, altered hydrological regimes and introduction of exotic plants and animals have degraded natural ecosystems, contributed to the extinction of some plant and animal species and compromised the base upon which agricultural production depends.



Ongoing, large-scale, human disturbances have reduced the resilience of the Central West landscape. Photos: Mikla Lewis (middle) and Brian Yap (bottom).



Why do we need to build landscape resilience?

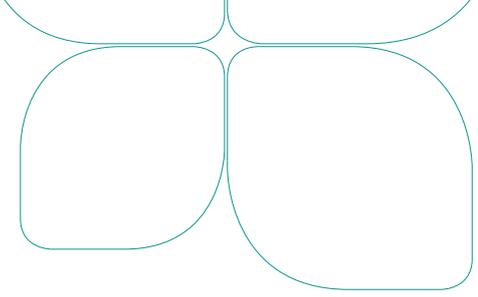
Landscapes with reduced resilience lose their ability to 'self-repair' and can quickly degrade. These landscapes often operate in an altered state where the nutrient cycles, water cycle, energy cycle and community dynamics are disrupted or changed. If the disturbance continues, landscapes may reach a point where they can no longer support these basic ecosystem processes.



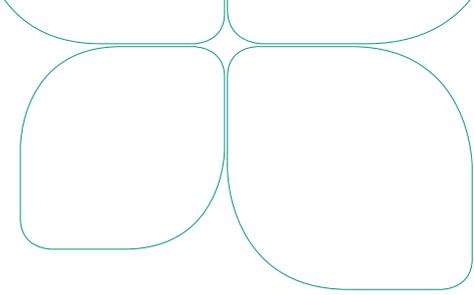
Ongoing disturbance to the landscape can result in a dysfunctional landscape that is unproductive and cannot sustain native plants and animals or agricultural production.

Restoring landscape resilience in an agricultural landscape such as the Central West region requires a concerted effort on private land. While the public reserve system protects core areas of 'intact' landscapes, many important vegetation communities, habitats and landscape features exist outside of these areas. National Parks and reserves are inadequate in both extent and diversity to sustain all species or to maintain broadscale ecosystem processes.





Agricultural production relies heavily on the natural resource base. If the resilience of the landscape is low, agricultural production may suffer.



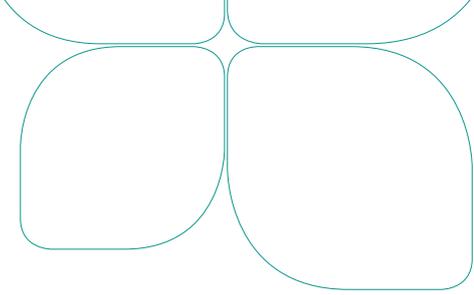
Landscapes with low resilience have less ability to recover from natural disturbances such as insect plagues, fires, floods, droughts and windstorms. Building landscape resilience can help to reduce the impact of catastrophic events.

Assessing landscape resilience

Landscapes with poor resilience tend to be simplified landscapes, with poor biodiversity however; even an overgrazed, weed infested area with no obvious native plants may still have some level of resilience.

Assessing the level of resilience of a landscape can be difficult and requires a good knowledge of the past disturbances and impacts. It may be easiest to broadly categorise landscape resilience on your property as either strong or reduced.





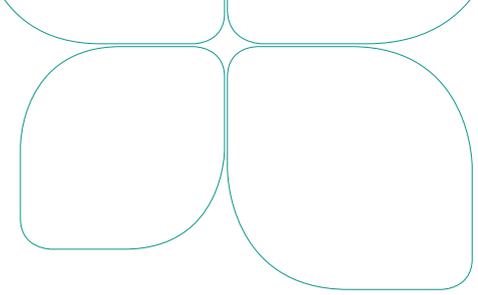
Strong resilience



Photos: Mikla Lewis.

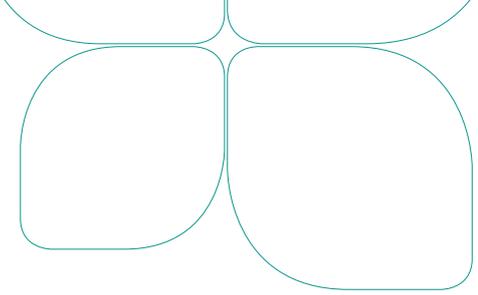
Key features

- A complex landscape with a variety of landforms and landscape features, soils types and habitat features.
- Good biodiversity—a large variety of plants and animals (different species, types, traits, ages), particularly native plants and animals.
- Plants that are sensitive to disturbance, such as orchids, may be present.
- Healthy vegetation and good vegetative cover (overstorey, understorey and groundcover), particularly native plants.
- Evidence of plants regenerating and animals reproducing, especially native plants and animals.
- Few weeds or invasive plants.
- Few invasive animals.
- Little to no evidence of land or water degradation.



Reduced resilience





Heavy weed load

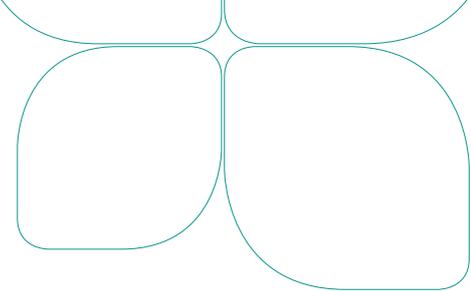


Simplified landscape

Photo (bottom): Alexandra Murray

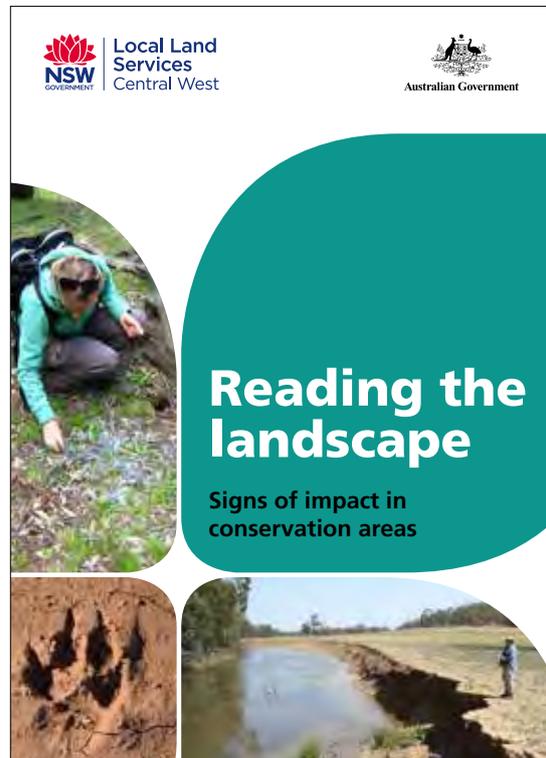
Key features

- Simplified landscape.
- Poor biodiversity—poor plant and animal diversity, monocultures.
- Poor plant health and vegetative cover including tree dieback, heavy insect or mistletoe infestations and/ or evidence of overgrazing.
- No evidence of plant regeneration or animal reproduction.
- Invasive plants and heavy weed loads.
- Large populations of invasive animals.
- Degradation such as soil erosion, soil structure and fertility issues, salinity, poor water quality.



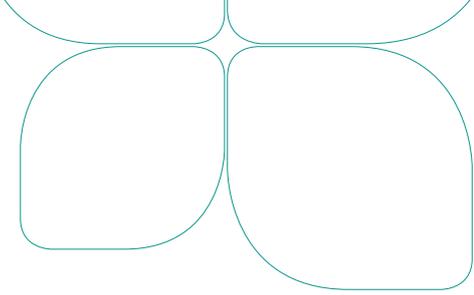
More information on many of these features can be found in other Central West Local Land Services publications *Reading the landscape: signs of impact in conservation areas* and *Recognising habitat features: a guide to identifying habitat on your property*.

By assessing landscape resilience you can help to set priorities when it comes to undertaking actions to build resilience. Start by protecting and enhancing areas that have the greatest resilience, as the condition of the landscape or ecosystem can be improved relatively easily. Then tackle the areas that are more highly disturbed and have lower resilience. These sites will likely take more time and effort to rehabilitate because issues such as weeds and land degradation problems will need to be remedied first.



A photograph of a natural landscape featuring numerous small, orange, mushroom-like fungi growing in a field of dry, brown grass and sparse green vegetation. The fungi have a rounded, ribbed cap and a thin, reddish-brown stem. The background is slightly blurred, showing more of the same fungi and dry grass. A teal-colored circular graphic is overlaid in the bottom-left corner, containing white text.

**Building
landscape
resilience**

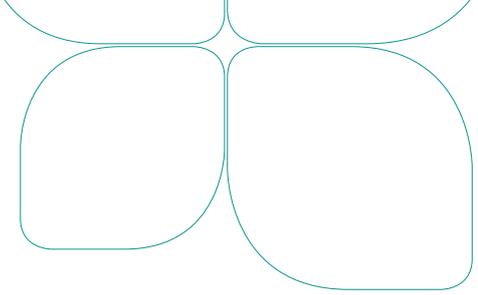


Building landscape resilience

The notion of ‘building landscape resilience’ may seem daunting but many landholders are already taking steps to repair degraded, damaged or destroyed ecosystems and prevent land or water degradation, which are key aspects of building landscape resilience.

Typical activities that some landholders are already doing that help to build landscape resilience include:

- protecting, planting and managing native vegetation
- restoring and protecting habitat for wildlife
- protecting waterbodies and riparian areas (land adjacent to waterbodies)
- addressing land degradation issues such as soil erosion and salinity
- improving grazing management practices to maintain groundcover and encourage species diversity
- improving cropping practices to conserve or enhance soil properties and optimise water use efficiency
- improving pasture and crop species selection and rotations to improve perenniality, biodiversity, benefit from natural symbiotic relationships, reduce weeds and pests and take advantage of nutrient availability
- controlling invasive plants and animals
- farm planning, taking into consideration natural assets and land capabilities, setting aside areas for conservation and production and creating ‘mosaic’ farms
- improving their knowledge of landscape management by participating in research, field days and training.



Improved grazing management



Conservation farming equipment

Many landholders are already taking positive steps that will help to re-build landscape resilience. Photo (bottom left): Mikla Lewis.

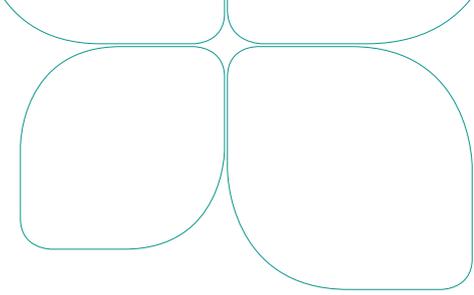


Revegetation

While all of these activities are a great step towards stronger landscape resilience, there are some key concepts outlined in this section that landholders should consider when planning these (and other) activities to help restore ecosystem processes and further improve landscape resilience.



Conservation of vegetation



Remove or reduce disturbances

Removing or reducing the frequency and intensity of disturbances such as clearing, burning, grazing, ploughing and heavy chemical use will assist the landscape to recover and help to prevent degrading processes from further reducing the resilience of the landscape.

Some disturbance is necessary to promote renewal and generate biodiversity and it may take some time to establish the right level of disturbance to help landscapes recover and become self-sustaining.



Reducing large-scale disturbances such as burning can allow landscapes to recover. Photo: Noel Dawson.

Allow time for recovery

Consider the current state of the landscape and ecosystem, the level of disturbance that has occurred in the past and whether it might have strong resilience or reduced resilience as this may influence the length of time it takes for the site to recover.



Landscapes with a lower resilience that have been highly disturbed will need longer to recover than landscapes with stronger resilience and less disturbance.

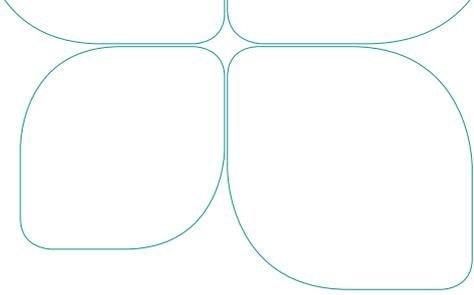
Protect, improve, enhance and reconstruct native vegetation communities

Native vegetation (overstorey, understorey and groundcover) is essential to maintain many ecological processes. Within the Central West region, some vegetation communities have been so extensively cleared that less than 10 per cent of their original extent remains. This removal of deep rooted, perennial, native vegetation and destruction of habitat has significantly reduced the resilience of the local landscape.

Protecting, improving, enhancing and reconstructing areas of native vegetation will have a number of benefits for both agricultural production and the health of ecosystems and the wider landscape. Some of these benefits are listed on the facing page.

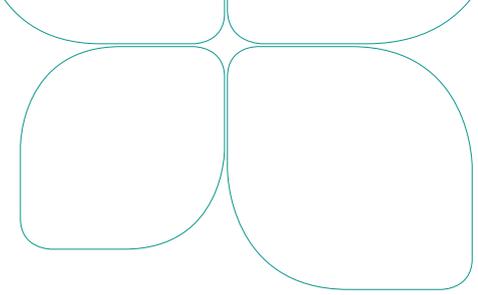


Native vegetation is incredibly important when it comes to building landscape resilience. Photo: Mikla Lewis.

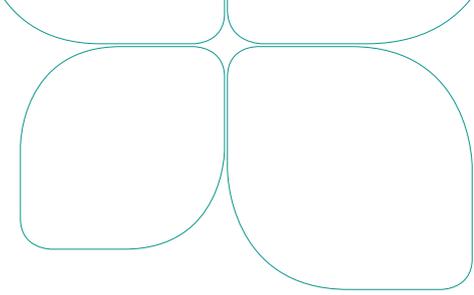


Ecological and agricultural benefits of native vegetation:

- provides essential food, shelter and breeding habitat for wildlife, particularly threatened species
- provides corridors that enable wildlife movement
- health benefits for stock such as improved weights, reduced stress and lower mortality rates—vegetation shades and shelters livestock, especially shorn sheep and young lambs and calves
- protection of crops and pastures from damaging winds
- increased pollination of crops
- reduction of pests—vegetation provides habitat for animals that control pests such as birds, bats, possums, gliders and reptiles
- prevention of erosion—native trees, shrubs and groundcover help stabilise the soil and shelter it from wind and rain
- prevention of salinity and other hydrological benefits—native vegetation can help to balance the watertable and hold water in the landscape as a buffer against extreme weather
- assists with nutrient cycling, bringing nutrients from deep in the soil profile to the surface. It can also benefit ‘decomposers’ such as termites and ants, which decompose plant material, aerate the soil and spread seeds.
- improves water quality—native vegetation helps to filter nutrients and sediment from entering waterways
- improves property and aesthetic values
- removes carbon and releases oxygen into the atmosphere.



Native vegetation can have ecological benefits such as providing habitat for wildlife as well as agricultural benefits such as shelter for stock and improved water quality. Photos: J. Lemon/ OEH (top left), Michael Van Ewijk/ OEH (top right), Mikla Lewis (bottom).



Protect

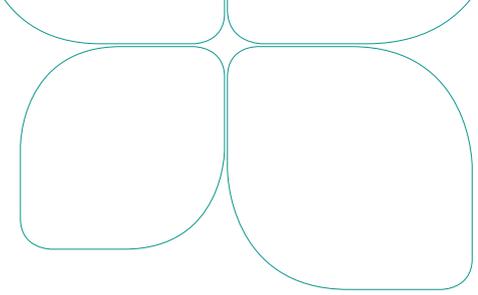
Protecting existing, mature native vegetation should be a priority for conservation efforts and is more cost-effective than trying to rehabilitate degraded areas.

Protect existing native vegetation using fencing or other management options to control grazing. Control invasive animal species and other unwanted visitors that may destroy vegetation or habitat.



Fencing can be used to help protect existing vegetation and manage grazing.

When protecting, improving, enhancing and reconstructing native vegetation, try to select sites where you may get multiple landscape benefits for example, the tops of hills to help manage rising watertables or along watercourses to improve water quality.

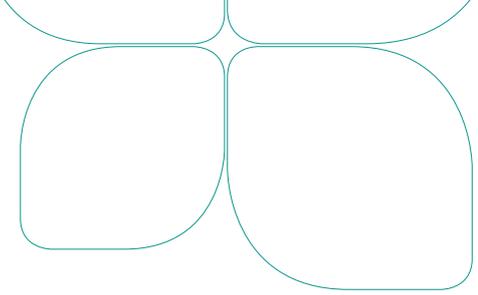


Improve

Improve the quality of existing native vegetation through management actions such as strategic grazing, controlling invasive plant and animal species, encouraging regeneration and plant diversity, stabilising land degradation issues and restoring habitat features.



Native vegetation can be improved by undertaking management actions such as controlling pest animals, encouraging regeneration, stabilising land degradation and restoring habitat features. Photos (bottom left and above): Mikla Lewis.



Enhance

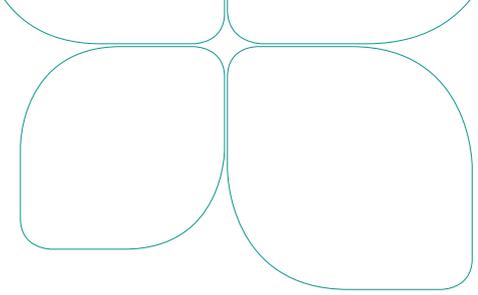
Enhance and enlarge existing patches of native vegetation using regeneration or revegetation techniques to replace 'missing' species, create buffers, fill in gaps or establish linkages to other remnant vegetation or habitat.



Endemic shrub species have been direct seeded on this site to replace the understorey. Photo: Mikla Lewis.



This riparian corridor has been enhanced through revegetation to widen it, which will act as a buffer for the creek as well as providing additional habitat for wildlife. Imagery: © CNES 2004/2005, reproduced under licence from Spot Image, all rights reserved.

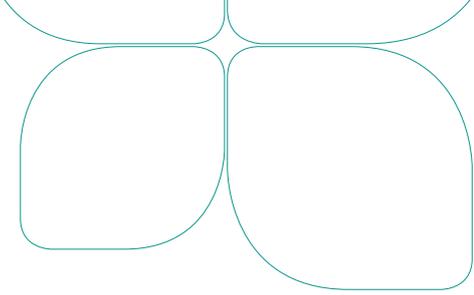


Reconstruct

Reconstruct new patches of native vegetation by promoting natural regeneration or revegetating. Use an appropriate species mix, suited to the local environment and landscape position and incorporate sufficient structural complexity to provide habitat for a range of flora and fauna.



Revegetation can help to build landscape resilience by restoring native vegetation in overcleared landscapes, enhancing existing remnant vegetation and providing connectivity between patches of vegetation. Photo (bottom): Mikla Lewis.



Size (and shape) matters

The health of native vegetation can be affected by the size and shape of the patch. Consider a single paddock tree—while they are often large, mature trees, they are very much exposed to things such as wind storms, insect attack and spray drift. As figure 1 below shows, larger, more compact blocks of vegetation will be less exposed to 'edge effects' and the habitat within them will be healthier.

Large areas (over 10 Ha) are particularly valuable because they are more viable and are more likely to survive in the long-term. If your site is smaller than this, you may need to consider enlarging it by promoting regeneration or revegetating.

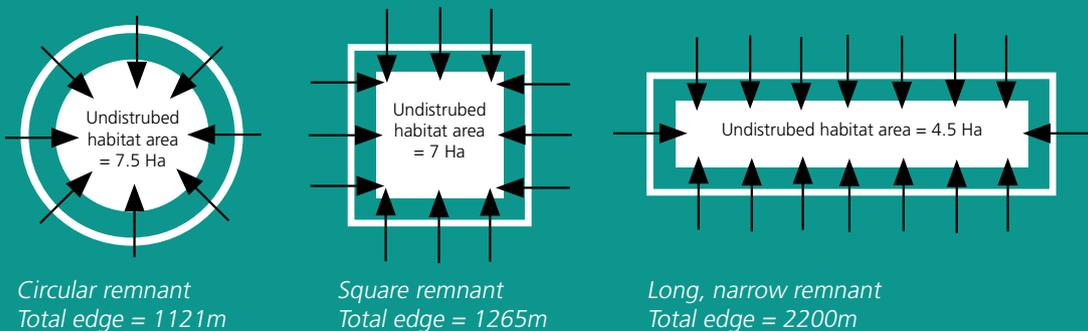
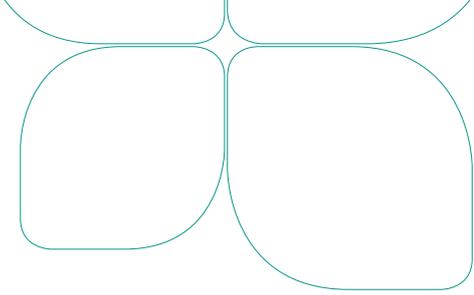


Figure 1: Size, shape and edge effects. Each remnant area is 10 Ha in size. With an edge effect of 25 m, the circular remnant has the most undisturbed habitat area, while the long, narrow remnant has the least undisturbed habitat area.



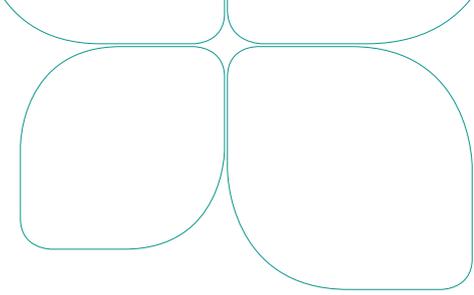
Promote diversity and complexity

Biodiversity underpins landscape resilience and functional ecosystems. The more diversity there is, the greater the resilience. When designing a farm plan, projects on your property, or even your cropping and pasture rotations, avoid uniformity. Aim for variety and complexity and spatial variation (patchiness).

For example, when undertaking native vegetation projects seek to vary the patch types (existing remnant, patches adjacent to existing remnants and new patches), patch size and shape (though larger patches are preferred) and landscape position (riparian areas, ridges, slopes as well as low-lying, productive areas). Build complexity within the site by ensuring there is floristic and structural diversity (different plant species and types such as trees, shrubs and groundcovers), and a variety of habitat features.



*Biodiversity is the key to landscape resilience.
Photo: Mikla Lewis.*



Improve connectivity within the landscape

The Central West landscape has become 'fragmented', where patches of vegetation and habitat are no longer connected. These patches can only sustain a limited number of plant and animal species and many animals, particularly arboreal (tree dwelling) animals may not travel between the patches. Populations of these animals may become extinct if they are unable to move in response to changes in resource availability, natural catastrophes and climate change.

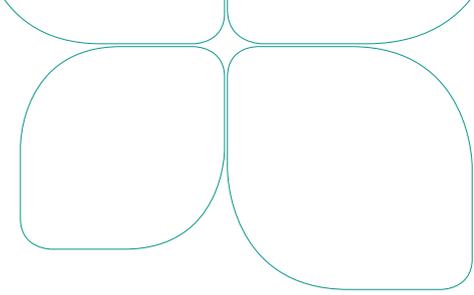
The long term survival of both plant and animal species also relies on the movement of genes from one population to another over many generations. Isolated patches may become inbred leading to local or regional extinctions.



Some native animals are happy to travel across open areas and barriers while others need protection from suitable habitat in order to move through the landscape. Photos (bottom left and above): Mikla Lewis.



Planting wildlife corridors to connect patches of remnant vegetation will counter habitat fragmentation, connect gene pools and enable wildlife movement and recolonisation. If wide enough, corridors can also provide additional habitat and greater opportunities for foraging, social interaction and breeding. The remnant vegetation will also benefit from seed dispersal and pollination, providing a flow of genes from one patch to another and fostering a more resilient vegetation community.



Creating landscape connectivity

Connectivity can be achieved in a number of ways including:

- expanding the area of existing remnants
- creating landscape linkages including corridors (linear strips that link patches of native vegetation) and stepping stones (small patches located between existing patches of native vegetation)
- amalgamating nearby patches to form a single larger patch
- reducing the hostility of the land outside of the patches for native fauna by 'softening' the boundaries between different land uses and reducing the intensity of the land use in between the patches. For example, maintain some habitat features like paddock trees, fallen logs and rocks in grazing and cropping paddocks and increase the area of native pastures
- strategically planning different land uses and farming rotations and incorporate refuge areas in high intensity land use areas.

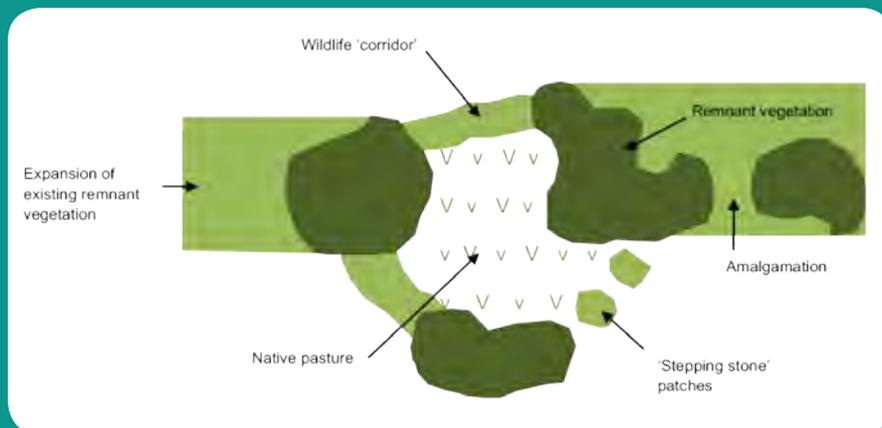
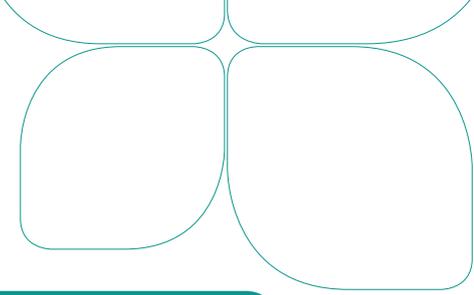


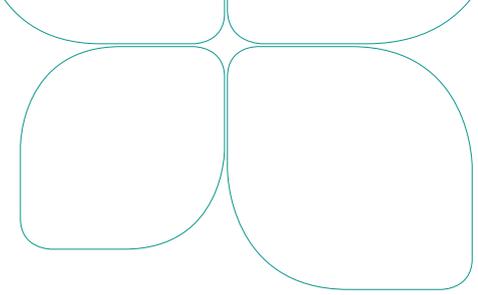
Figure 2: Landscape connectivity can be improved by expanding or amalgamating existing remnants, creating corridors or stepping stones between patches of remnant vegetation and by reducing the hostility of the land in between patches of vegetation.



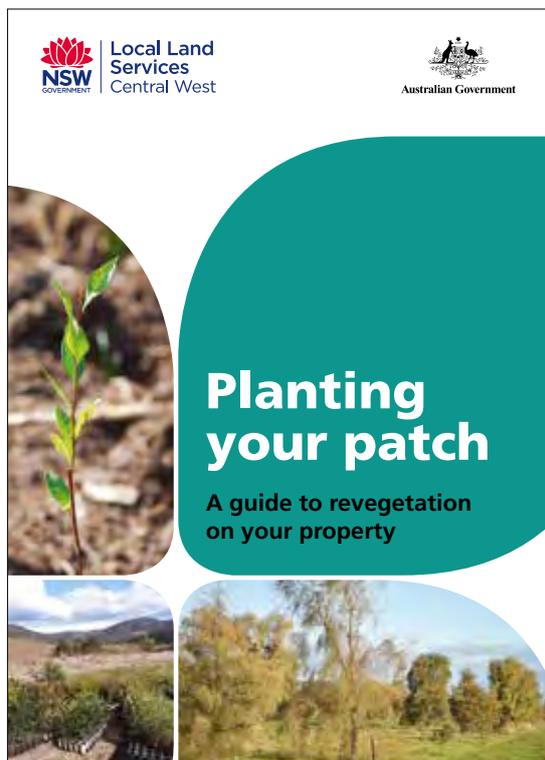
Effective landscape linkages

When planning and reconstructing landscape linkages there are a number of concepts you should consider to maximise the benefit of the corridor or linkage. This includes:

- retain or expand existing natural links, where possible, rather than creating new habitat
- to be effective, wildlife corridors should connect at least two patches of remnant vegetation. Try to avoid or reduce gaps that include barriers such as roads, which can inhibit the movements of small mammals.
- consider the purpose of the corridor and the wildlife that you are wanting to support. This may influence the landscape position, size (length and width) and shape of the corridor, the plant species you use and the way you manage it. Some wildlife will not enter linkages if the habitat does not suit them or the quality is poor, even if destination is pristine.
- when planning new linkages, follow natural movement pathways (if known) such as migratory routes or daily foraging patterns, if possible. Following natural features such as rivers, drainage lines and ridges can also be beneficial. Try to locate linkages away from sources of human disturbance such as highways.
- incorporate other habitat features into your corridors such as mature paddock trees, rocky outcrops and fallen timber. These features will greatly increase the habitat diversity.
- size is important. In general, the wider the better. This creates a 'core' area that is free from edge effects and will provide habitat, rather than just a corridor for wildlife movement. Longer linkages must be wider to provide 'habitat for the journey'. Building small patch 'nodes' into the corridor may help if the entire corridor cannot be widened.
- habitat corridors are most effective when they contain a variety of open and dense areas and a high diversity of native plant species and types (mix of large and small trees, shrubs and groundcovers). Use endemic (locally occurring) plant species and try to mimic the natural composition and structure of the original vegetation community. Randomise the distance between individual plants and rows to increase the complexity of the habitat.
- design linkages to enable passive wildlife recolonisation. Provide links from known source populations (remnants) to restored sites (revegetated sites).
- remember that connectivity is more than wildlife corridors. Stepping stones, alternative land-uses and short-lived seasonal links may also achieve desired outcomes. Even single paddock trees can act as stepping stones for some species.
- monitor the success of the linkage against its original objectives. The effectiveness of the linkage may be increased through additional management such as provision of nest boxes or increased width.



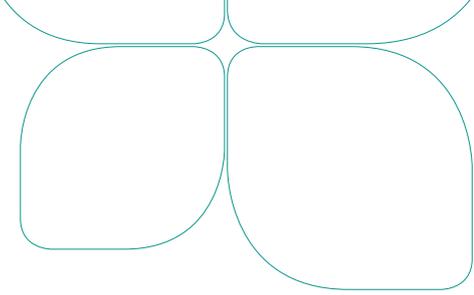
For more tips on designing and planting wildlife corridors, please talk to your Local Land Services Officer and ask for a copy of the guide *Planting your patch: a guide to revegetation on your property*.



Tools such as Google Earth, aerial photographs or satellite imagery (available from your Local Land Services office) can provide you with a birds-eye view of how the vegetation on your property sits within the landscape and allows you to recognise opportunities for new linkages at a landscape scale. Imagery: © CNES 2004/2005, reproduced under licence from Spot Image, all rights reserved.



Standing on top of a hill (if you have one nearby) can help you to gain some perspective on connectivity within the local landscape.



Repair ecosystem processes

Ecosystem processes are the basis for self-maintenance in a landscape. Disruptions to nutrient cycles, the water or energy cycle or community dynamics can impede the processes that help ecosystems to function and repair themselves, which reduces the resilience of landscape.

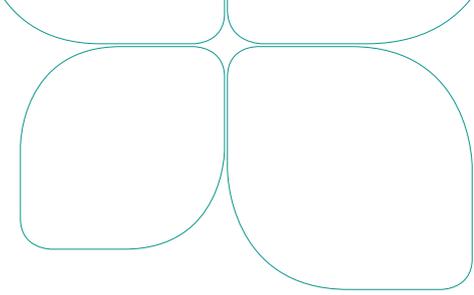
Ecosystem processes include such things as carbon fixation by plants (photosynthesis), nutrient cycling, nitrogen fixation, decomposition of organic matter, water filtration and cycling, pollination and seed dispersal.



Native vegetation plays an important role in ecosystem process such as carbon fixation, nutrient cycling and water cycling as well as providing habitat for wildlife.



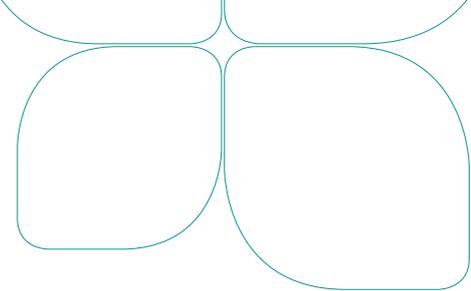
Insects such as ants are important decomposers, nutrient cyclers, pollinators and seed dispersers.
Photo: Mikla Lewis.



Repairing ecosystem processes

Actions that can help to maintain or restore ecosystem processes include:

- ensuring you have good vegetative cover across your property and minimising bare areas
- protecting, enhancing and improving existing native vegetation and habitat areas
- revegetating by allowing natural regeneration, direct seeding or planting tubestock—use of local, endemic species that produce nectar, seed and fruit is particularly important
- strategic grazing to encourage plant regeneration and diversity
- fire management to preserve vegetative cover and habitat features and to encourage plant regeneration and diversity
- minimising the use of chemicals and fertilisers as these may affect organisms that play important ecosystem roles
- protecting soil properties through conservation farming, residue retention and grazing management
- controlling aggressive or invasive plant and animal species to restore natural community dynamics
- landscape engineering may be necessary in cases where the landscape is unable to repair itself or to prevent further damage. This may include works such as constructed waterways and erosion control, water spreading or water ponding.
- maintaining key habitat and landscape features such as mature trees with hollows, fallen logs, rocks and quality water sources.



Minimise bare ground



Plant and protect endemic vegetation



Manage fire appropriately



Improve grazing practices to protect the soil



Control invasive species



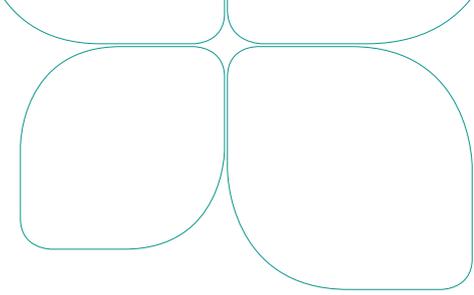
Use landscape engineering works to help the landscape to repair itself



Protect key habitat features



Protect key landscape features



Take a holistic approach

Take a holistic approach to the management of your property by integrating production with conservation and considering the long-term and wider landscape impacts of your activities.

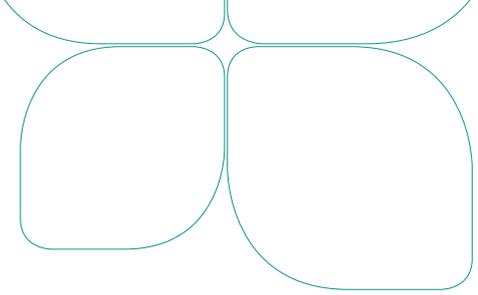


Long-term production and conservation go hand-in-hand. Photo: L. Bonham.

At times it may seem like your efforts are futile so, whenever possible, participate in catchment planning and work with your neighbours and local Landcare group to tackle broader landscape issues.



It may be a good idea to set a landscape vision as a group. Considerations may include: What is the landscape like now? How do you want it to look and function? How will you get there? What are the timeframes? How will you monitor it? What's feasible?



Catchment planning can help to tackle broader-scale landscape issues

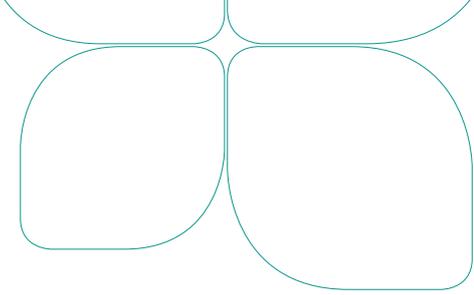
Learn more about landscape management by attending field days and training and keep in touch with your Local Land Services Officer who can keep you informed of educational and funding opportunities.



Attending field days and training can help to improve your natural resource management and productivity.



Appendix



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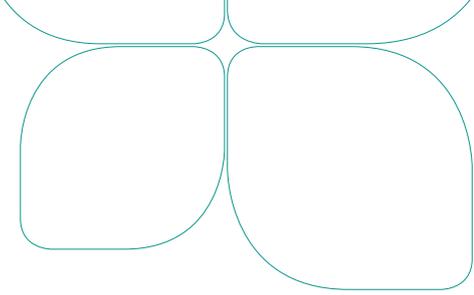
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